United States Department of the Interior

U.S. GEOLOGICAL SURVEY
3916 Sunset Ridge Road
Raleigh, NC 27607

August 27, 2012

Ms. Candice Teichert
Remedial Project Manager
Superfund Site Evaluation Section
Superfund Division
U.S. Environmental Protection Agency
61 Forsyth Street
Atlanta, GA. 30303

Dear Candice,

As per your recent discussions with Melinda Chapman, please find enclosed the Quality Assurance Project Plan (QAPP) for the upcoming borehole geophysical logging work and surface geophysical surveys to be conducted by U.S. Geological Survey North Carolina and South Carolina Water Science Centers in selected wells and areas near the Barite Hill/Nevada Goldfields Superfund Site near McCormick, South Carolina. The work should take place during September 2012 through September 2013. We will be in contact with you to schedule specific dates in the field. If you have any questions, please do not hesitate to call me at (919) 571-4000.

Sincerely,

Holly S. Weyers, Director
USGS, North Carolina Water Science Center

Enclosure
Cc: Melinda Chapman, Project Chief
Rose Pinnix, Administrative Officer

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SECTION A: Project Planning Elements		
A1. Title (Project Name)	**Barite Hill/Nevada Goldfields Superfund Site**	
Project Location:	McCormick, McCormick County, South Carolina	
Project Requestor and Organization:	Candice Teichert EPA Region 4/Superfund Division/Superfund Site Evaluation Section 61 Forsyth Street Atlanta, GA 30303	
Project Leaders Name, Position, and Organization:	Melinda Chapman, Groundwater Specialist USGS NC WSC	
Project Leaders Signature:		Date:
Technical Reviewer's Name and Position:	Benjamin Bentkowski, Hydrogeologist U. S. EPA Region 4 / Superfund Division/ Technical Services Section	
Technical Reviewer's Signature		Date:
A3. Distribution List		
Benjamin Bentkowski	US EPA Region 4, Superfund Division, Atlanta, GA	
A4. Project Personnel (list below):	**Organization**	**Responsibilities**
Melinda J. Chapman	USGS NC WSC, Raleigh, NC	Project Chief
Brad A. Huffman	USGS NC WSC, Asheville, NC	Field Supervisor
Bernice A. Allen	USGS NC WSC, Raleigh, NC	Health and Safety Advisor
Kristen B. McSwain	USGS NC WSC, Raleigh, NC	Project/Field Hydrologist
William S. Caldwell	USGS NC WSC, Raleigh, NC	Field Hydrologist
Whitney Stringfield	USGS SC WSC, Columbia, SC	Health and Safety Advisor
Timothy H. Lanier	USGS SC WSC, Columbia, SC	Field Hydrologist
William F. Falls	USGS SC WSC, Columbia, SC	Field Hydrologist

Matthew D. Petkewich	USGS SC WSC, Columbia, SC	Field Hydrologist
James E. Landmeyer	USGS SC WSC, Columbia, SC	Field Hydrologist
A5. Problem Definition (Objectives) and Background:	The Barite Hill area borehole geophysical logging and surface geophysical surveys addresses the delineation and orientation determination of bedrock fractures, areal and vertical contaminant distribution within the regolith and bedrock in selected areas, and discharge of contaminated groundwater to surface water in the surrounding creek, as related to potential conductive contaminant migration in the groundwater system.	
A6. Project Description:	This project will include the collection of borehole geophysical logs from five open-borehole and an estimated five screened wells. Logs to be collected include caliper, electrical resistivity, fluid temperature and resistivity, and natural gamma logs, optical televiewer images, and potentially heat-pulse or electromagnetic flowmeter (both ambient and stressed). Water-quality profiles also will be run in the screened wells using a multi-probe. Surface geophysical surveys will include the use of an electromagnetic conductivity meter to delineate areas of conductive contaminant plumes in five selected locations and delineation of groundwater discharge areas in the surrounding creek using fiber-optic distributed temperature sensing methods.	
Decision(s) to be made based on data/interpretations:	US EPA will use these interpretations of fracture depth and orientation, and borehole and surface contaminant distribution, to assess potential source areas of conductive groundwater contamination, the potential for the migration of contaminated groundwater offsite, potential areal expansion of sampling, and design of remediation activities at the Barite Hill Superfund site.	
Field Study Dates:	September 2012 through February 2013	
Projected completion date for USGS Scientific Investigations or Open-File Series Report describing results/interpretations:	September 30, 2013	
A7. Quality Objectives and Criteria: All borehole geophysical logs and surface geophysical surveys are collected under the guidance of experienced USGS borehole and surface geophysical personnel and groundwater hydrologists. USGS Office of Groundwater Branch of Geophysics provides ongoing internal training and guidance on		

borehole geophysical logging and surface geophysical surveys.
A8. Special Training/Certfications: All personnel collecting borehole geophysical logs and running surface geophysical surveys in the field have completed either the 40-hour Hazwoper safety training or 8-hour HazWoper refresher safety training, and have completed baseline medical surveillance.
A9. Documents and Records: IAG DW #14946085

Section B: Data Generation and Acquisition
B1. Sampling Design: Wells to be logged and surface geophysical survey areas will be selected in coordination with EPA and their consultants based on spatial distribution and presence of conductive groundwater contamination and known areas of low pH/high specific conductance surface water occurrence.
B2. Sampling Methods: Completion of the borehole geophysical logging of the three newly drilled open-borehole bedrock wells will be under the guidance of EPA and their consultants in order to minimize driller standby time. Logging of the two existing open-borehole bedrock wells and selected screened wells will be conducted during drilling activities logging downtime for the new wells. Digital geophysical logs and images will be made available to the US EPA and their consultants as soon as the data have been quality assured. USGS NC WSC field personnel will follow data collection procedures as described in internal training documents from the USGS Office of Groundwater Branch of Geophysics (http://water.usgs.gov/ogw/bgas/g2t.html) and USGS NC WSC Groundwater Quality Assurance Plan. Additional discussion of borehole logging methods is presented in the following publications: USGS fact sheet "Advances in Borehole Geophysics for Ground-Water Investigations, (http://water.usgs.gov/ogw/bgas/publications/FS-002-98/); USGS Techniques of Water-Resources Investigation Report Book on "Borehole Geophysical Methods Applied to Groundwater Investigations" (http://pubs.usgs.gov/twri/twri2-e2/); and the US EPA Region 4 Field Branches Quality System and Technical Procedures [1], (http://www.epa.gov/Region4/sesd/fbqstp/), where applicable. All field notes regarding logging system setup, tool testing, weather conditions, water level, well identification, and other logging notes will be recorded in a log book. Water-quality probe profiling in selected screened wells will be conducted using internal USGS quality assurance plan guidance (http://nc.water.usgs.gov/usgs/info/qaplan/quality.html). Surface geophysical surveys will be conducted under guidance of the USGS Office of Groundwater Branch of Geophysics (http://water.usgs.gov/ogw/bgas/). All data will be made available to the EPA and their consultants as soon as it has been quality assured. An overview of the fiber-optic distributed temperature sensing method is described here http://water.usgs.gov/ogw/bgas/fiber-optics/.
B3. Sample Handling and Custody: All borehole geophysical tools and the downhole logging cable will be rinsed using a diluted

[1] http://www.epa.gov/region4/sesd/fbqstp/index.html

Alconox solution and deionized water prior to, and after logging each well, to prevent cross contamination. Decontamination procedures will be tested by collecting dissolved ion and metals samples of the rinse water and submitting to USGS National Water Quality laboratory, Denver, Colorado, for analysis.

B4. Analytical Methods:
USGS NC WSC personnel will use WellCad software to display and interpret geophysical logs and images for fracture delineation, including depth and orientation. Rockworks software will be used to create structural diagrams and three-dimensional fracture rendering. Equipment specific interpretation software will be used to process the surface geophysical data. Data will be exported to report figures and potentially imported into ArcGIS software if possible. The major ion/metals borehole tool rinse list of constituents will be forwarded to the EPA for their review prior to sample collection.

B6. Instrument/Equipment Testing, Inspection, and Maintenance:
All borehole geophysical tools, water-quality profile probes, and surface geophysical equipment are calibrated in the manufacturer's factory during initial configuration or servicing. Additionally, the caliper tool is calibrated in the field using two representative diameters for the well casing and open borehole diameter. The heat-pulse and electromagnetic flowmeter tools will be tested in a standpipe the office prior and subsequent to field deployment. The optical televiewer magnetometer will be compared to a magnetic compass in the field each week. Borehole tools and the logging cable are regularly inspected for signs of wear. Water-quality probe calibration is conduted on the first day of field work and checked during following days. Field calibration of the fiber-optical distributed temperature sensing cable is conducted daily during data collection activities.

B7. Instrument/Equipment Calibration and Frequency:
The caliper tool is calibrated at each well to be logged to insure proper reading of borehole diameter. The heat-pulse flowmeter tool will be tested prior to and subsequent to field logging using a standpipe and pump in the office. The OTV tool magnetometer will be tested each week in the field against a hand-held magnetic compass. The water-quality profiling probe will be calibrate the morning prior to first use, and checked each morning of field work thereafter. The fiber-optic distributed temperature sensing cable will be checked continually during field data collection.

B8. Inspection/Acceptance of Supplies and Consumables	N/A

B9. Non-direct Measurements:
Field electromagnetic conductivity surveys will be conducted by walking over selected areas of investigation along profile lines. Locations of line end points will be surveyed using a differential global positioning system. Measurement points along the profile lines will be surveyed for distance and land-surface altitude change.

B10. Data Management:
All borehole geophysical data will be processed using WellCad software for interpretation of

fracture depths and orientations. These data will be provided to the US EPA and their consultants in both electronic spreadsheet and area diagram (rose/stereonet) format. Well water-quality profiles will be forwarded using electronic spreadsheets. Surface geophysical surveys will be processed using manufacturer software and exported for report figures and potentially linked to an ArcGIS map. Both borehole and surface geophysical data and interpretations will be archived electronically in accordance with USGS Office of Groundwater policy.

Section C: Assessment and Oversight Elements

C1. Assessments and Response Actions:
An assessment of the dominant fracture depths and orientations and vertical contaminant distribution profiles will be provided for each well logged to the US EPA Technical Reviewer. Identification of water bearing fractures will be noted and correlated with other fracture characteristics in the area as data are available. These borehole fracture orientations will be compared to surface geologic mapping data in the vicinity of the wells if available from previous surface geologic mapping. Surface geophysical surveys will be compared to resistivity surveys conducted earlier in some overlapping areas.

C2. Reports to Management:
A USGS Scientific Investigations or Open-File Series report will be prepared to provide borehole geophysical log fracture interpretation, vertical conductive contamination profiling, and surface geophysical areal conductive plume and groundwater discharge area summary results to the US EPA Technical Reviewer. All data and interpretations will be provided in electronic format. This report will be released to the public online after EPA and USGS approval.

Section D: Data Validation and Usability Elements

D1 Data Review, Verification, and Validation:
USGS NC WSC field personnel will follow data collection procedures as described in internal training documents from the USGS Office of Groundwater Branch of Geophysics and USGS NC WSC Groundwater Quality Assurance Plan and the US EPA Region 4 Field Branches Quality System and Technical Procedures (http://www.epa.gov/Region4/sesd/fbqstp/), where applicable. All data will be reviewed by USGS colleagues and EPA personnel as part of the USGS report review process.

D2 Verification and Validation Methods:
If available, downhole geophysical fracture orientations will be correlated with surface geologic mapping data. Vertical conductive plume profiling in selected wells will be compared to available groundwater-quality data from the same wells. Overlap of surface geophysical methods in areas of known conductive plume contamination will be conducted where possible. These methods have been approved by the USGS as part of the proposal requirements.

D3. Reconciliation and User Requirements	N/A